

**Article IV.**—DESCRIPTION OF A SKULL OF THE EXTINCT  
MADAGASCAR CROCODILE, *CROCODILUS ROBUSTUS*  
VAILLANT AND GRANDIDIER<sup>1</sup>

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With Prefatory Note by W. D. Matthew

PLATE IV

PREFATORY NOTE

With the following article Dr. Mook begins a series of contributions to the osteology, affinities, and distribution of the Crocodilia, based primarily upon the study of the collections of fossil and Recent crocodiles in The American Museum of Natural History. Through the courtesy of the United States National Museum and the good offices of Mr. C. W. Gilmore, the entire collection of extinct crocodiles of that institution has been placed at his disposal for comparative study. We are no less indebted to Dr. Samuel Henshaw and Dr. Thomas Barbour, of the Museum of Comparative Zoology, for the loan of a series of skulls and skeletons of existing and extinct Crocodilia, including several species difficult to secure for comparison. Dr. A. G. Ruthven, of the University of Michigan has kindly loaned several skulls of South American crocodiles.

It is intended to publish the results of these researches in the form of a series of short contributions, dealing first with the later Tertiary and post-Tertiary species, then the early Tertiary forms, and afterwards the Mesozoic crocodiles, leading up to a general revision of the order.

W. D. MATTHEW.

In commencing this series of contributions upon the Crocodilia, the writer desires to express his acknowledgements to Professor Osborn and Doctor Matthew for the opportunity to study and describe the collections of fossil crocodiles in The American Museum of Natural History; to the American Museum Department of Herpetology; to Mr. C. W. Gilmore, of the United States National Museum; to Dr. Thomas Barbour, of the Museum of Comparative Zoology; and to Mr. A. G. Ruthven, of the University of Michigan, for the loan of specimens for comparison and for permission to publish the results in certain cases where it seemed advisable.

The following description, based upon a skull in the collection of the Museum of Comparative Zoology, is published by permission of the director of that Museum, Dr. Samuel Henshaw, and of Dr. Thomas Barbour.

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<sup>1</sup>Contributions to the Osteology, Affinities, and Distribution of the Crocodilia. No. 1.

The skull here described was collected by F. R. Wulsin near Antsirabe, Madagascar, and was figured by Dr. Barbour in 1918,<sup>1</sup> with notes on the validity of *C. robustus* as a species, the conclusion being that it is valid as a fossil species but does not exist at the present time, the large forms referred to it being very old individuals of *C. niloticus*. The geological horizon of the skull is unknown; it is probably late Pleistocene.

#### GENERAL FORM

The size of the specimen is small, but its proportions are stout. The breadth across the quadrato-jugal bones, across the cranial table, across the base of the snout, between the two canine grooves, and across the anterior part of the snout is in each case relatively great in proportion to the length of the skull. The premaxillary region is especially broad in proportion to its length; the length of these bones from the premaxillary-maxillary suture on the palate to the tip of the snout is only about two-thirds the maximum breadth across the premaxillaries.

The snout is exceedingly short, being only about one and one-sixth times as long as broad at the base. The posterior half of the external narial opening is bordered by a distinct ridge. A distinct ridge extends inward and backward from each canine groove to the nasal bone; from the nasal bone to the median line it becomes less distinct and finally disappears. Each of these ridges makes an angle of about 45° with the longitudinal axis of the skull. The superior portion of the premaxillo-maxillary suture roughly follows this ridge, but is slightly more transverse in direction. Posterior to each of these oblique ridges is a conspicuous depression; this depression lies over the fourth and fifth maxillary teeth. Posterior to these depressions is another pair of elevations extending obliquely inward and backward from the alveolar border; these elevations contain the roots of the fifth maxillary teeth. In front of each orbit a ridge extends anteriorly and externally from the superior border of the orbit, turning directly forward a short distance in front of the orbit; it dies out at the level of the seventh maxillary tooth. This ridge does not converge toward its opposite as in *C. porosus*, nor does it extend as far forward as in that species; the two ridges are also relatively farther apart than in *C. porosus*. The pitting is rough, relatively fine-textured on the ridges but coarser-textured between them. The two ridges are continued backward along the superior borders of the orbits, and along the external borders of the cranial table. The interorbital region is practically flat, or slightly concave; it is of moderate breadth. A prominent elevation is located between the anterior portions of the

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<sup>1</sup>Bull. Mus. Comp. Zool., LXI, No. 14.

orbits; it is situated entirely upon the anterior process of the frontal bone, and occupies most of this process.

The cranial table is concave laterally, and slopes conspicuously downward anteriorly. On the posterior border a pair of small processes extends backward, lying directly behind the supratemporal fenestræ. The table is very broad in proportion to its length; it is much narrower anteriorly than posteriorly, the lateral borders converging anteriorly. Each postero-external corner is elevated into a thick process which is very conspicuous.

The festooning of the jaw, seen laterally, consists of a straight maxillary border, a deep canine notch, a rapid descent from this to the level of the fourth and fifth maxillary teeth, then a slight rise to the level of the posterior end of the seventh maxillary tooth, a slight descent to the level of the tenth maxillary tooth, and finally a slight rise further back. From above is seen a relatively slight constriction at the canine notches, an expansion to the level of the fifth and sixth maxillary teeth, then a very slight constriction at the base of the seventh maxillary tooth. This posterior constriction differs from the corresponding constriction in most crocodile skulls in being situated nearer to the orbits than to the canine notch. The surface of the palate is concave in its anterior portion.

#### CAVITIES OF THE SKULL

**EXTERNAL NARIAL OPENING.**—This cavity is almost circular, but is slightly broader than long. The nasal bones project very slightly into the cavity itself.

**ORBITS.**—The orbits are large. They are almost as broad as long, and their anterior ends are bluntly pointed. They are situated near the middle of the skull, the antorbital region being little longer than the post-orbital.

**SUPRATEMPORAL FENESTRÆ.**—These fenestræ are of medium size and are irregularly oval in outline. They are relatively far apart; their longest axes approach each other at an angle of about  $45^{\circ}$ .

**INFRATEMPORAL FENESTRÆ.**—The infratemporal fenestræ are large; they contrast with those of most crocodiles in being at least two-thirds as long as the orbits. The sharp infratemporal processes of the quadratojugs are not present in the specimen, evidently having been broken off.

**INFERIOR PREMAXILLARY FORAMEN.**—The borders of this cavity are not preserved, but the cavity itself was evidently large.

**PALATINE FENESTRÆ.**—These cavities are relatively large, especially in the transverse direction. They extend as far forward as the center of the space between the seventh and eight maxillary teeth on the left side and the posterior part of the seventh tooth on the right side.

#### BONES OF THE SKULL

**PREMAXILLARIES.**—These bones are remarkable for their great breadth in proportion to their length, and the nearly uniform size and relatively uniform spacing of the teeth. The first, third, and fifth teeth are practically the same in size; the fourth is a little larger than these, and the second is a little smaller; the third and fourth are slightly farther apart than the others.

The premaxillo-maxillary suture on the palate is irregular, but is transverse in general direction. Its farthest posterior extension is only to the level of the center of the first maxillary tooth. On the superior surface, the suture extends as far back as the center of the space between the first and second maxillary teeth. The suture extends almost directly inward from each canine notch to a point near the nasal and then turns sharply backward. It crosses the ridge mentioned above. A pair of shallow pits is situated between the first and second premaxillary teeth, and internal to them, for the reception of the first mandibular teeth.

There is a similar pit between the third and fourth teeth, and a very shallow one between the fourth and fifth.

**MAXILLARIES.**—The maxillaries are very broad in proportion to their length. The sutures with the nasals are short; those with the lacrymals are more nearly antero-posterior in direction than transverse. The superior portions of the maxillo-jugal sutures are more nearly transverse in direction than antero-posterior. Nearer the inferior borders of the skull they curve backward, finally bending abruptly downward to the border in nearly vertical lines.

On the palate the maxillaries have twelve teeth on each side. The variation in the size and spacing of these is relatively slight. The maxillary teeth increase regularly in size from the first to the fifth. All of these are close together. The sixth is about the same size as the fourth and is close to the fifth. A shallow pit is situated between the sixth and seventh teeth, partly in line with the teeth themselves and partly internal to them. A larger pit is similarly situated between the seventh and eighth teeth. The seventh tooth is about equal in size to the eighth. The eighth, ninth, tenth, eleventh, and twelfth teeth are all close together and about equal in size, which is about that of the second or third

maxillary teeth. The maxillo-palatine suture extends directly inward from the palatine fenestra about one-third of the distance between this fenestra and the median line; it then curves sharply forward and meets its mate in a fairly sharp point on the midline at the level of the anterior border of the sixth maxillary tooth. About one-half of the external border and one-fifth of the internal border of each palatine fenestra are composed of the maxillary bone. The suture with the ectopterygoid begins at the level of tenth maxillary tooth and extends back a short distance behind the twelfth tooth.

**NASALS.**—The nasal bones are short and broad. They constrict slightly immediately behind the posterior processes of the premaxillaries but expand again near the anterior end of the contact with the lacrymals. The naso-lacrymal sutures extend straight back to the anterior end of the naso-prefrontal contact. The latter contacts converge slightly posteriorly. The naso-frontal contact is in the form of a broad V.

**LACRYMALS.**—These bones are relatively large, much larger, in fact, than the prefrontals. The length of the naso-lacrymal suture is relatively great, being about one-third as long as the maxillo-nasal suture. The lacrymals carry the preorbital ridges.

**PREFRONTALS.**—The prefrontals are relatively small; their length is considerable in proportion to their breadth. Each prefronto-lacrymal suture extends in a direct antero-posterior direction through the anterior two-thirds of its length; its posterior portion turns outward toward the inferior border of the orbit. The prefrontals carry the anterior portions of the supraorbital ridges.

**FRONTAL.**—The single frontal bone carries part of each supraorbital ridge; its anterior portion carries a small median elevation; this anterior process is about equal in length to the broader portion of the bone. The orbital borders of the frontal are very short. The suture with the parietal is not very distinct, but it appears to be anterior to the supratemporal fenestræ, the frontal not entering these cavities. The median postorbital portion of the bone is deeply sculptured.

**POSTORBITALS.**—The postorbital bones are not especially characteristic.

**PARIETAL.**—This is characterized by very deep sculpturing. It carries a pair of bony prominences back of the supratemporal fenestræ. It appears to reach the posterior border of the skull around the supra-occipital, but the sutures in this region are not distinct. The distance between the two supratemporal fenestræ is greater than the length of the fenestræ themselves.

**SQUAMOSALS.**—The squamosals are large and massive. The postero-external corners are elevated into prominent protuberances. The sutures with the exoccipitals are obscure.

**SUPRAOCCIPITAL.**—This bone appears to extend back a considerable distance on the superior surface of the skull; this cannot be determined accurately because of the obscure nature of the parieto-supraoccipital suture. The other sutures are equally obscure.

**JUGALS.**—These bones are not especially characteristic.

**QUADRATO-JUGALS.**—The quadrato-jugals lack the sharp antero-superior processes which are characteristic of *Crocodylus* and *Tomistoma*. They were probably present originally but have not been preserved. The bones are not especially characteristic.

**QUADRATES.**—The quadrate bones are not especially characteristic.

**PALATINES.**—The palatines are relatively short and broad. The maxillo-palatine suture has been described above. The palato-pterygoid suture bends forward as in *C. palustris*.

**ECTOPTERYGOIDS.**—The left ectopterygoid only is preserved, and it is not complete. The bone does not appear to be especially characteristic. The pterygo-ectopterygoid sutures divide the posterior borders of the palatine fenestræ into two equal portions.

**EXOCCIPITALS, BASIOCCIPITAL, PERIOTICS, ALISPHENOIDS, AND BASISPHENOID.**—None of these bones exhibit characters which are of sufficient value to require special description.

#### MEASUREMENTS

|                                                                                       |          |
|---------------------------------------------------------------------------------------|----------|
| Length of Skull, Median                                                               | 30.0 cm. |
| Breadth Across Premaxillaries                                                         | 9.7      |
| Length of Premaxillaries on Palate                                                    | 6.4      |
| Breadth Across Canine Groove                                                          | 8.2      |
| Length, Anterior End of Palatine to Premaxillary-maxillary Suture                     | 6.4      |
| Length, Anterior End of Palatine to Tip of Snout                                      | 12.1     |
| Length, Anterior End of Palatine to Anterior End of Internal Nares                    | 13.2     |
| Length, Pmx.-Mx. Suture on Canine Groove to Anterior End of Ectopterygoid, Right Side | 12.7     |
| Breadth Across Last Alveoli                                                           | 15.7     |
| Length, Maxillary Alveolar Border, Left                                               | 15.0     |
| Length, Maxillary Alveolar Border, Right                                              | 14.7     |
| Length, Palatine Foramen, Left                                                        | 8.5      |
| Breadth, Palatine Foramen, Left                                                       | 4.6      |
| Breadth, Palatines at Maxillo-palatine Suture                                         | 4.5      |
| Breadth Across Maxillaries at 6th Maxillary Tooth                                     | 13.7     |
| Breadth Across Maxillaries Posterior to 7th Maxillary Tooth                           | 13.5     |
| Breadth Across Quadrates                                                              | 21.3     |

|                                                                        |             |
|------------------------------------------------------------------------|-------------|
| Breadth Across Quadrato-jugals                                         | 23.1 (est.) |
| Breadth Across Posterior End of Cranial Table                          | 13.8        |
| Breadth Across Anterior End of Cranial Table                           | 9.6         |
| Length of Cranial Table                                                | 8.2         |
| Length, Maxillo-nasal Suture, Left                                     | 5.3         |
| Length, Maxillo-nasal Suture, Right                                    | 5.8         |
| Length, Lacrymo-nasal Suture, Left                                     | 1.9         |
| Length, Lacrymo-nasal Suture, Right                                    | 1.9         |
| Length, Frontal Border of Orbit, Left                                  | 1.75        |
| Length, Frontal Border of Orbit, Right                                 | 1.65        |
| Length, Anterior End of Orbit to Posterior End of Cranial Table, Left  | 13.6        |
| Length, Anterior End of Orbit to Posterior End of Cranial Table, Right | 13.0        |
| Length, External Nares                                                 | 3.1         |
| Breadth, External Nares                                                | 3.3         |
| Breadth of Snout at Base                                               | 15.5        |
| Length of Snout                                                        | 18.7        |
| Length, Anterior End of Orbit to Canine Groove, Left                   | 13.2        |
| Length, Anterior End of Orbit to Canine Groove, Right                  | 13.3        |
| Breadth Between Orbits                                                 | 4.1         |
| Breadth Across Preorbital Ridges                                       | 6.4         |
| Breadth Across Orbits, Maximum                                         | 12.9        |
| Breadth Across Supratemporal Fenestræ, Maximum                         | 6.6         |
| Breadth Between Supratemporal Fenestræ                                 | 1.8         |
| Length, Anterior End of Orbit to Tip of Snout, Left, Perpendicular     | 18.9 (est.) |
| Length, Anterior End of Orbit to Tip of Snout, Left, Oblique           | 19.4        |
| Length, Anterior End of Orbit to Tip of Snout, Right, Perpendicular    | 16.3 (est.) |
| Length, Anterior End of Orbit to Tip of Snout, Right, Oblique          | 17.6        |
| Length, Orbit, Left                                                    | 5.5         |
| Length, Orbit, Right                                                   | 5.4         |
| Breadth Orbit, Left                                                    | 5.2         |
| Breadth, Orbit, Right                                                  | 5.2         |
| Length, Supratemporal Fenestra, Left, Oblique Maximum                  | 3.3         |
| Length, Supratemporal Fenestra, Right, Oblique, Maximum                | 3.1         |
| Length, Infratemporal Fenestra, Left                                   | 2.5         |
| Length, Infratemporal Fenestra, Right                                  | 2.3         |

## REMARKS

The relations of this crocodile are unknown. The short, robust proportions, the transverse premaxillo-maxillary suture on the palate, and the relatively great breadth of the premaxillary bones suggest *C. palustris* and *C. rhombifer*. In other respects, however, this form differs considerably from either of these species. Until more is known of the adaptive, convergent, and palæotelic characters of the Crocodilia, it seems best to make no statement regarding the relationships of *Crocodylus robustus*.

PLATE IV

Skull of *Crocodilus robustus* Vaillant and Grandidier

In the Museum of Comparative Zoology

About three-tenths natural size

Fig. 1. Lateral view, left side

Fig. 2. Superior view

Fig. 3. Inferior view

After Barbour





